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Hiroyuki KASHIWADANI* and Syo KUROKAWA*: Notes on Japanese and Formosan species of *Anthracothecium* (1)**

柏谷博之*・黒川　逍*: 日本および台湾産のニキビゴケ属について (1)

(Plate XI)

The lichen genus *Anthracothecium* belongs to the Pyrenulaceae and includes about 95 species, most of which are distributed in tropical and subtropical regions. Species of the present genus resemble pyrenocarpous lichens such as those of *Parmentaria* and *Pyrenula* especially in external appearances. However, they can be clearly separated from species of the related genera by the simple ascocarps with terminal ostioles and by the muriform brown spores.

In the present area, species of *Anthracothecium* have been insufficiently known or poorly understood. In Japan, the first record of species of this genus was made by Müller Arg. (1891), who described a new species, *A. laevigatum* Müll. Arg., basing on a specimen collected by M. Miyoshi. Vainio (1918, 1921) reported two species when he studied A. Yasuda's collections: *Bottaria* (Anthracothecium) *variolosa* (Pers.) Vain. and *Anthracothecium olivaceocinereum* Vain. In 1931, Asahina recorded the occurrence of *A. variolosum*, though he also recognized the presence of two other unnamed species in Japan. From Formosa, on the other hand, only two taxa of *Anthracothecium* have been reported by Zahlbruckner (1933). At present, consequently, four species and one variety of *Anthracothecium* have been reported from the present area; they are *A. angulatum* Zahlbr., *A. angulatum* var. *majus* Zahlbr., *A. laevigatum*, *A. olivaceocinereum* and *A. variolosum* (Pers.) Müll. Arg.

As the result of our examination of about 150 specimens preserved in TNS, we will report eight species of the genus from the present area; they are *A. asahinae*, *A. japonicum*, *A. laevigatum*, *A. majus*, *A. manipurense* Müll. Arg., *A. oculatum* Müll. Arg., *A. pachycheilum* (Tuck.) Zahlbr., and *A. vermicularis*.

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Among them, *A. asahinae*, *A. japonicum*, and *A. vermicularis* are new to science and a new combination, *A. majus* (Zahlbr.) Kashiw. et Kurok., is proposed here. *A. olivaceocinereum* reported by Vainio is not clearly typified in this paper, because muriform spores reported in original description and illustrated on the packet by Vainio were found neither in the holotype (TUR) nor in an isotype preserved in TNS, only 4-septate brown spores characteristic of *Pyrenula* being found.

The writers wish to express their cordial thanks to the curators of FH, G, H. TUR, and W for the loan of type specimens.

Morphology In all *Anthracothecium* species, the thallus is crustose and is poorly developed morphologically, forming a tightly attached colony on barks of various trees. In cross section, the thallus is composed of outer chondroid layer, gonidial layer, and medulla. The outer chondroid layer is composed of conglutinate hyphae, which show no distinct morphological differentiation. The gonidia belong to *Trentepohlia* in all species. The gonidial layer is situated under the outer chondroid layer and is continuous or discontinuous. The medulla is composed of very thin and densely branched hyphae, which are observed under the microscope with a little dificulty, though they are rather easily recognized when stained with lactophenol-cotton-blue. The hyphae penetrate into the tissue of substratum up to 300–700 μ in depth and form small clusters of hyphae in or between the bark cells. The color of medulla is constantly white in all species of the present area, but it is yellow to pale yellow in some tropical species, such as *A. depressum* Müll. Arg., *A. goniostomum* Müll. Arg., etc.

Ascocarps are usually immersed in the thallus or substratum and are of perithecial type in all species of *Anthracothecium*. In most species, ascocarps are subglobose or hemiglobose, while they are conical in *A. majus*, *A. manipurense*, etc. They are completely immersed in the thallus in younger stages, but they soon protrude on the thallus in most species. However, they are completely buried in the thallus and never protrude even in mature stages in *A. laevigatum*.

In all species of *Anthracothecium*, ascocarps are composed of two distinct tissues, involucrellum and proper exciple, as pointed out by Kurokawa (1955) for certain species of pyrenocarpous lichens. He considered that the two tissues had different origin; the former was derived from thalli and the latter from sexual organs. Recently, M.C. Janex-Favre (1970) demonstrated that the proper exciple (in the sense of Kurokawa) was derived from "envelope primaire", which had surrounded the carpocentre in the early stages of ascocarp development.

Involucrellum of *Anathacothecium* is composed of hyphae of thalline origin and often contains fragments of bark cells. It is highly "carbonized" or blackish brown pigmented. It is well developed in most species of the present genus such as *A. oculatum*, *A. japonicum*, and *A. manipurense*, though the length and the thickness are a little different in species. In contrast, it is poorly developed and is formed only around the ostiole in *A. laevigatum*, *A. pachycheilum*, etc.

The proper exciple of the ascocarp, as mentioned above, is found in all species of the present genus. In regards to the thickness and the presence or absence of crystals, the following two types are found in *Anthracothecium*.

1) *Pyrenula japonica* type (Plate1-1). As reported in *Pyrenula japonica* Kurok. by Kurokawa (1976), proper exciple of this type is very thin (ca. 10-15 μ thick) and contains no crystal. This type of proper exciple is found in *Anthracothecium japonicum*, *A. laevigatum*, *A. majus*, and *A. manipurense*. In the Pyrenulaceae, similar exciple is also observed in *Melanotheca*, *Pseudopyrenula*, and *Trypethelium*.

2) *Pyrenula nitida* type (Plate 1-2). Proper exciple of this type is usually thick (50-100 μ thick) and contains crystals of calcium oxalate, as in ascocarps of *Pyrenula nitida* (L.) Ach. It is generally thickest near the ostioles and is becoming thinner towards the base of ascocarp. The proper exciple of this type usually contains fairly large amount of crystals, by which it is easily distinguished from those of the *Pyrenula japonica* type. This type of exciple is found in *A. asahinae*, *A. oculatum*, *A. pachycheilum*, and *A. vermicularis*, though the crystals are constantly very few in *A. pachycheilum*.

Nucleus of *Anthracothecium* is subglobose or hemiglobose in most species, though it is typically conical in *A. japonicum*. While it is usually simple in species with exciple of the *Pyrenula nitida* type, it is often divided into two or more cavities at the lower half in species with exciple of the *Pyrenula japonica* type.

The hymenium is colorless, showing J (0.1% solution)+reddish brown reaction in most species, while it is J+blue or bluish yellow in *A. asahinae*, *A. majus*, *A. manipurense*, etc.

Chemistry As to the chemical substances, only two anthraquinoid pigments, fallacinal and parietin, have been reported from *A. ochraceoflavum* (Nyl.) Müll. Arg., a tropical species (Huneck and Follman, 1970). While the acetone residue yields no crystal in the ordinary reagents in most species of *Anthracothecium*, that of *A. laevigatum* and *A. pachycheilum* gives colorless needles (Fig. 1 A, B) or small clusters of short needles (Fig. 1 C) in GAW. The substance has not been identified with any known substance.

Key to the species of *Anthracothecium* in Japan and Formosa

1. Ascocarps of the *Pyrenula japonica* type; proper exciple thin (less than 20 μ thick), containing no crystal.
   2. Ascocarp 0.9–1.5 mm in diameter, covered with thallus; hymenium J+ reddish brown or −.
      3. Involucrellum thick (150–200 μ thick); asci 2-spored; spores 140–200 μ long .... *A. japonicum*
      3. Involucrellum poorly developed, present only around the ostiole and 30–40 μ thick; asci 8-spored; spores 14–20 μ long .... *A. laevigatum*
   2. Ascocarp 2–3.5 mm in diameter, not covered with thallus, hymenium J+ blue or yellowish blue.

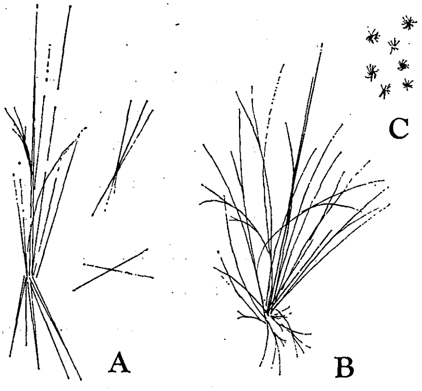


Fig. 1. Crystals of unknown substances of *A. laevigatum* (A) and *A. pachycheilum* (B, C) recrystalized in GAW, ×750.

4. Asci 8-spored; spores uniseriate, 60-80 μ long .... *A. majus*

4. Asci 4-6 spored; spores biseriate, 90-140 μ long .... *A. manipurense*

1. Ascocarps of the *Pyrenula nitida* type; proper exciple thick (50-100 μ thick), containing crystals of calcium oxalate.

5. Ascocarp more than 1 mm in diameter.

6. Asci 2-spored; spores transversely 14-16-septate and 170-220 μ long.... .... *A. vermicularis*

6. Asci 4-6 spored; spores transversely 6-10-septate and 90-110 μ long.... .... *A. oculatum*

5. Ascocarp less than 1 mm in diameter.

7. Involucrellum poorly developed (less than 20 μ thick); unknown substance present .... *A. pachycheilum*

7. Involucrellum well developed (50-100 μ thick); unknown substance absent .... *A. asahinae*

1) **Anthracothecium asahinae** Kashiw. et Kurok., sp. nov.

Thallus epi- et endophloeodes, crustaceus, fulvescens vel cinereo-stramineus, laevis, usque ad 10 cm diametro. Thallus crassiusculus; stratum corticale subchondroideum, 40-70 μ crassum; stratum gonidiale continuum, 30-50 μ crassum, gonidia ad *Trentepohliam* pertinentia, ca. 3×6 μ; medulla alba; hyphae medullosae inter cellulas substrati prorumpentens usque ad 600 μ in profundidate. Ascocarpus hemiglobosus, copiosus, vulgo 2-5 confluens, raro solitarius, prominens, fulvescens vel prope ostiolum niger, 0.5-0.8 mm diametro, ostiolo fusco, terminali. Ascocarpus semi-immersus, ambitum vulgo thallo tumidulo tectus; involucrellum excipulum tegens, fusco-nigrum, 50-100 μ crassum, basim versus 20-30 μ crassum; excipulum proprium integrum, cacium oxalicum continens, 50-60 μ crassum, basim versus 15-20 μ crassum; hymenium hyalinum, J+dilute aeruginosus vel caerulescens; nucleus subglobosus vel ad basim nonnihil applanata, 650-750 μ latus, 600-700 μ altus; paraphyses simplices vel pauce ramosae, anastomosantes; asci cylindrici, bitunicati, 8-spori; sporae biseriales, fuscae, transversim 7-9-loculatae, loculis 1-2(-3)-locellatis, 16-18×(35-)40-50(-55) μ.

Chemistry. Only little acetone residue.

Type collection. Japan, Honshu, Prov. Izu, Mt. Amagi, Y. Asahina 54—holotype in TNS.

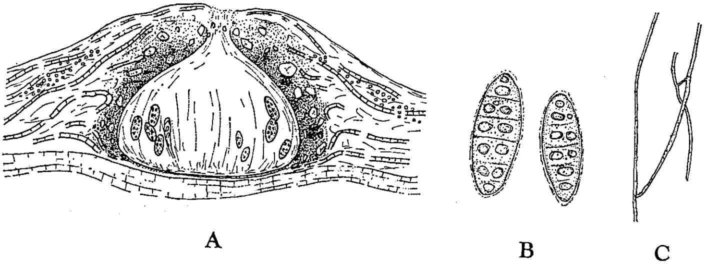


Fig. 2. *Anthracothecium asahinae* Kashiw. & Kurok. A: Cross section of ascocarp, ×50. B: Spores, ×500. C: Paraphyses, ×500.

Although Asahina did not give any latin name, he reported the present species from Mt. Amagi, central Japan in 1931. Critical study on this specimen proved that it is a morphologically and chemically distinct species.

Anthracothecium asahinae is characterized by ascocarp covered with thallus, exciple containing many crystals of calcium oxalate (*Pyrenula nitida* type), thick involucrellum covering the exciple, white medulla, small spores of ca. 17×45 μ in size, and J+pale blue reaction in the hymenium.

Anthracothecium asahinae resembles two Philippine species of *Anthracothecium*, *A. erythrinae* (Vain.) Zahlbr. and *A. submucosum* (Vain.) Zahlbr., from which it differs in having hymenium showing pale greenish blue or blue reaction with J.

This species has been collected on trunks or twigs of *Acer*, *Camelia*, *Daphniphyllum*, etc. It seems to be endemic to Japan.

Specimens examined. Japan. Honshu. Prov. Hitachi: Daigo, Kuji-gun, K. Yoshitake 6700 (TNS). Prov. Musashi: Mitsumine, Y. Asahina s. n. (TNS); Mt. Takao, Y. Asahina s. n. (TNS). Prov. Izu: Joren-no-taki Water Fall, Y. Asahina s. n. (TNS); Mt. Amagi, S. Kurokawa 57027 (TNS). Prov. Suruga: Vicinity of Gotemba, S. Kurokawa 540050 (TNS). Shikoku. Prov. Iyo: Omogo Gorge, Mt. Ishizuchi, T. Makino s. n. (TNS).

2. **Anthracothecium japonicum** Kashiw. et Kurok., sp. nov.

Thallus epi- et endophloeodes, crustaceus, fulvescens vel olivaceus, late expansus, ad 10-30 cm diametro. Thallus crassiusculus; stratum corticale subchondroideum, hyalinum vel pallido-brunnescens, 90-110 μ crassum; stratum gonidiale continuum, 20-30 μ crassum; gonidia ad *Trentepohliam* pertinentia, ca. 3×5 μ; medulla alba; hyphae medullosae inter cellulas substrati prorumpentens usque ad 700 μ in profundidate. Ascocarpus prominens, hemiglobosus, solitarius vel raro 2-3 confluens, plerumque thallo obtectus, fulvescens, demum saepe fere omnino denudatus, niger, 1-1.5 mm diametro, ostiolo fusco, terminali. Ascocarpus semi-immersus; involucrellum excipulum tegens, crassum, fusco-nigrum, 100-160 μ crassum; excipulum proprium tenuissimum, crystalia non continens, 10-15 μ crassum; nucleus conicus, 500-700 μ latus, 500-750 μ altus; hymenium hyalinum, J+rubescens; paraphyses simplices vel pauce ramosae, raro anastomosantes; asci cylindrici, bitunicati, 2-spori; sporae fuscae, oblongae, transversim 10-15-loculatae, loculis 12-20-locellatis, 30-45(-55) × (120-)140-200(-240) μ.

Chemistry. Only little acetone residue.

Type collection. Japan. Hokkaido. Prov. Ishikari: Noborikawa, Yubari-city, on bark of *Acer* sp., elevation about 350 m, H. Shibuichi (no. 6067) and K. Yoshida—holotype in TNS.

Anthracothecium japonicum is characterized by the well-developed involucrellum, which covers the exciple from the top to the base but not at the bottom, the very thin exciple containing no crystal of calcium oxalate (*Pyrenula japonica* type), the conical nucleus, the hymenium showing J+reddish brown reaction, the 2-spored asci, and the large spores (140-200 μ in length) with numerous locelli.

Anthracothecium japonicum is apparently closely related to *A. epapillatum* (Nyl.) Müll. Arg., a species reported from Ceylon (Hook. et Thoms. 2226—

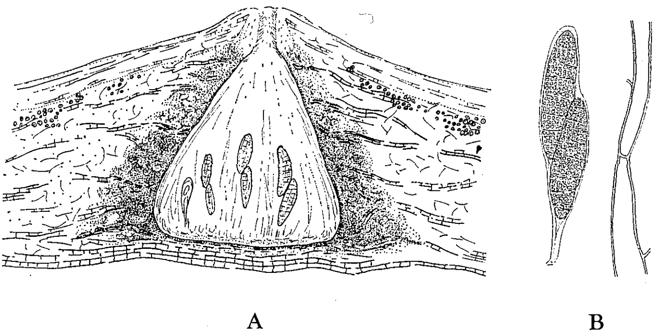


Fig. 3. *Anthracothecium japonicum* Kashiw. & Kurok. A: Cross section of ascocarp, ×50. B: Ascus and spores, ×125. C: Paraphyses, ×350.

holotype in H, Herb. Nyl. 4). Both of these species have exciple covered with thick involucrellum and the hymenium showing J+reddish brown and the spores are very similar in size and shape. However, the involucrellum of *A. japonicum* are well developed as mentioned above, whereas that of *A. epapillatum* is resticted to the upper half of the exciple. In addition, nucleus is conical in *A. japonicum*, but it is subglobose to hemiglobose in *A. epapillatum*.

In Japan, *A. japonicum* has long been misidentified as *A. variolosum*, probably because both species have developed involucrellum and large spores similar in shape and size. However, it is clearly separated from the latter species by the exciple of the *Pyrenula japonica* type rather than the exciple of the *Pyrenula nitida* type found in *A. variolosum*.

Although this species seems to be endemic to Japan, it is rather widely distributed in mountain regions from Hokkaido to Shikoku, where it grows on bark of deciduous broad-leaved trees such as *Acer*, *Fagus*, etc.

Specimens examined. Japan. Hokkaido. Prov. Shiribeshi: Mt. Katsuma, Okushiri Island, on bark of *Fagus crenata*, elevation about 340 m, H. Kashiwadani 14707, 14713, 14715 (TNS); Mt. Kamui, Okushiri Island, on bark of *Acer sieboldianum*, elevation about 320 m, H. Kashiwadani 14745 (TNS); Monai, Okushiri Island, on bark of *Fagus crenata*, elevation about 5 m, H. Kashiwadani 14785 (TNS). Honshu. Prov. Mutsu: Yunokawagoe Pass, Shimokita Peninsula, S. Kurokawa 56301 (TNS). Prov. Hitachi: Mt. Yamizo, Daigo-cho, Kuji-gun, K. Yoshitake 2353 (TNS). Prov. Kozuke: Mt. Akazawa, Azuma-gun, on bark of *Acer mono*, S. Kurokawa 550498 (TNS). Prov. Musashi: Hinata-Ohya, Ryogami-mura, Chichibu-gun, on trunks of *Carpinus* sp., S. Kurokawa 550522 (TNS). Prov. Sagami: Hakone-Gongen Shrine, Hakone, Y. Asahina 73, 76 (TNS); Mt. Ohyama, Naka-gun, M. Ogata s. n. (TNS); Mt. Kintoki, Hakone, S. Kurokawa 58054 (TNS). Prov. Izu: Mt. Amagi, K. Hisauchi s. n. (TNS); the sama locality, S. Kurokawa 57026, 57028 (TNS). Prov. Suruga: Gotemba, Y. Asahina 4 (TNS); Vicinity of Gotemba, S. Kurokawa 540034, 540055, 540060 (TNS); Morinokoshi, Gotemba, M. Togashi (Herb. Y. Asahina 549010, 549013, TNS). Prov. Yamashiro: Umegahata, Takao, Kyoto, T. Komiya s. n. (TNS). Prov. Settsu: Mt. Myoken, Y. Asahina s. n. (TNS). Prov. Tamba: Ohyama-mura, Taki-gun, M. Ogata s. n. (TNS). Shikoku. Prov. Tosa: Befukyo Gorge, Monobe-mura, Kami-gun, H. Kashiwadani 14942, 16036 16037, 16038 (TNS).

3. **Anthracothecium laevigatum** Müll. Arg., Nuov. Giorn. Bot. Ital. **23**: 130 (1891). Type collection. Japan, Shikoku, Tosa, M. Miyoshi 136—holotype in G.

Thallus epi- and endophloeodes, yellowish brown, smooth or minutely areolate. Outer chondroid layer of thallus hyaline, 80-100 μ thick; gonidia belonging to *Trentepohlia*, 3×5 μ in size; medulla white, medullary hyphae penetrating into the tissue of substratum up to 600 μ in depth. Ascocarp solitary or 2-4-confluent, completely immersed in the thallus; ostiole blackish brown, terminal. Ascocarp flask-shaped, 0.4-0.5 mm in diameter; involucrellum poorly developed, formed only around the ostiole, dark brown, 30-40 μ thick; exciple thin, containing no crystal, 10-20 μ thick; nucleus subglobose, 300-350 μ in diameter, 400-450 μ in height; hymenium J− or very pale reddish brown; paraphyses very rarely branched, very rarely anastomosed; asci bitunicate, 8-spored; spores brown to dark brown, uniseriate, slightly constricted at the middle, rounded at both ends, muriform, transversely 1-3-septate, 7-8×14-20 μ, each transverse section 3-5-locellate. The thallus containing unknown substance which yields colorless needles in GAW.

Anthracothecium laevigatum is easily distinguished from the allied species of *Anthracothecium* by the small flask-shaped ascocarps which are totally immersed in the thallus, the poorly developed involucrellum, the exciple of the *Pyrenula japonica* type, and the small (14-20 μ long) spores with rounded ends. When a section of the thallus is heated with GAW, the unknown substance is easily recrystalized as colorless needles among the medullary hyphae (Fig. 1 A). This species is, at present, known only from the type locality.

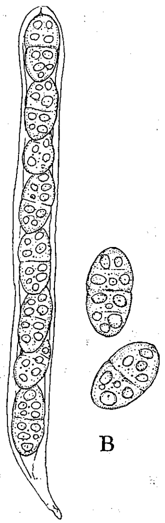


Fig. 4. *Anthracothecium laevigatum* Müll. Arg. A: Ascus, ×460. B: Spores, ×500.

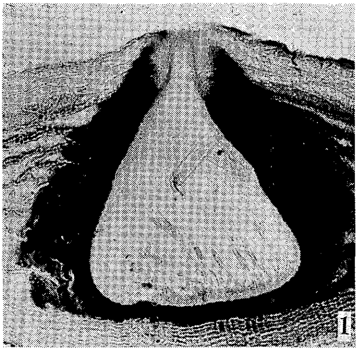
Explanation of plate XI

1: Cross section of ascocarp of *Ahthracothecium japonicum* Kashiw. & Kurok., ×60.
2: Cross section of ascocarp of *Anthracothecium asahinae* Kashiw. & Kurok., ×60.
3: *Anthracothecium asahinae* Kashiw. & Kurok. Holotype, ×1.7.
4: *Anthracothecium japonicum* Kashiw. & Kurok. Holotype, ×1.7.
5: *Anthracothecium laevigatum* Müll. Arg. Holotype, ×1.7.
6: Cross section of ascocarp of *Anthracothecium laevigatum* Müll. Arg., ×60.

□青葉高：**野菜，在来品種の系譜** 332+10 pp. 1980. 法政大学出版部，東京．本書は二部から成るが，第二部の在来品種の特性と伝播経路というのが本論である。ことにカブに重点を置いて各府県毎の在来品種を苦心して集め，それらの来歴をつきとめ，栽培法を追究し，品種の各形質を研究していることが深く広い。そして近藤万太郎氏が見出だし，渋谷茂氏が発展されたカブ種を水に浸した時に水胞状に膨出する東洋系カブの品種と全然膨出しない西洋系カブ類との著るしい差が中部と近畿両地方を境にカブララインとして存在するという中尾佐助氏の説を展開して論じているのは面白い。其他，附随的にツケナ，タカナ，ルタバガ，ダイコン，キュウリ，ナス，マクワウリ，ネギ，ゴボウ，ニンジン等についても種々論じてある。　(前川文夫)

□諏訪教育会自然研究部(編)：**諏訪の自然誌，植物編** pp. 682, 1981. 諏訪教育会，諏訪，非売品．これは第3巻で地質編，動物編に引きつづき出版されたもの。多くの委員が調査に参加し25年を経てできたものであるだけに充実している。何しろ本州の中部で諏訪湖及び霧ヶ峰，八ヶ岳，釜無山系等を含む広大な地域であるだけに内容はすぐれている。はじめにカラー印刷のページで大要を摑ませ，総論では主として植物の種類と分布に重点をおき，各論では10地域に分けて分布を論じ，別に霧ヶ峰と八ヶ岳の縞枯現象などに特に注意をはらっている。資料として11ヶ所について全植物の分布表をあげてる。分布論といい，分布表といいレベルの高いものといえよう。　(前川文夫)

□日刊さつき研究社：**ウチョウラン写真集，栽培法付** 192 pp. 内写真 160 pp., 1980. ¥2,500. ウチョウランの多形に亘る花の異相をカラー写真で現わしたもので，こうも多種に亘るかといぶかわれる程であり，自然の種の区別をいずこに置くかが疑問となる程である。日本では近頃天然にあるものを漁りつくすかの観を呈するが，一方人工による栽培と多変化とを実際に迎えて一つの方向の目安を抱くに到ったともとれる。はたして喜ぶべきか否か，一つの道として認められるものではあろう。　(前川文夫)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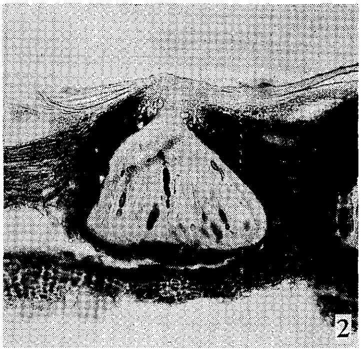
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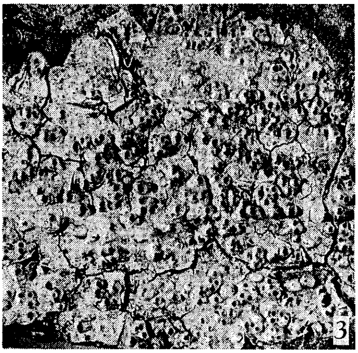
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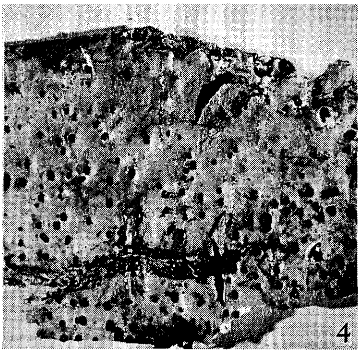
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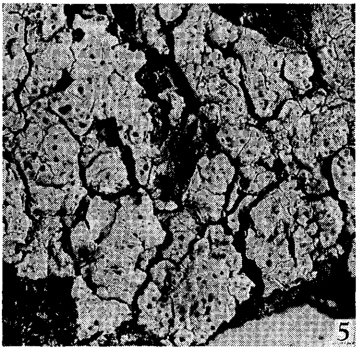
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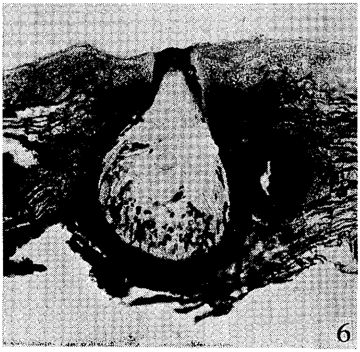
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H. KASHIWADANI & S. KUROKAWA: Japanese and Formosan *Anthracothecium*